AMENDMENTS TO THE SPECIFICATION:

Please amend the paragraph beginning at page 1, line 11, as follows:

A directional coupler is a well known four port element for radio frequency equipment. This device allows a sample of a radio or microwave frequency signal, which is provided to an input port and received at an output port, to be extracted from the input signal. Properly designed, the directional coupler can distinguish between a signal provided to the input port and a signal provided to the output port. This characteristic is of particular use in a radio frequency transmitter in which both the transmitted signal and a signal reflected from a mismatched antenna can be independently monitored. To obtain such performance, directivity of the coupler should be very high. Directivity of the coupler is high if so called "compensation conditions" are fulfilled. There are two compensation conditions, assuming validity of quasi-static approximation: 1) the capacitive and inductive coupling coefficients are equal, and 2) the coupler is terminated with the proper impedances (preferably 50 Ohms) – for more details see for instance: K. Sachse, A. Sawicki, Quasi-ideal multilayer two- and three-strip directional couplers for monolithic and hybrid MICs, IEEE Trans. MTT, vol. 47, No. 9, Sept. 1999, pp. 1873 – 1882. <u>Definitions of the coupling coefficients and effective dielectric constants used in the Detailed Description can be found in: K. Sachse, The scattering parameters and directional coupler analysis of characteristically terminated asymmetric coupled transmission lines in an inhomogeneous medium, IEEE Trans. MTT, vol. 38, No. 4, April 1990, pp. 417-425, eq. (2), and the caption of Fig. 7.</u>

Please amend the paragraph beginning at page 2, line 7, as follows:

A good solution for these types of couplers is utilizing pure strip line configuration with homogeneous dielectric media. Unfortunately, this solution can be applied only for ~~the~~ couplers built as separate components. They can not, or can hardly be applied in an integrated circuit environment where transmission lines carrying a power signal are integrated mainly on the top surface of, or placed beside a multilayer printed board.

Please amend the paragraph beginning at page 3, line 19, as follows:

The possibility of adjusting the distance between the tuning ground plane(s) and the first line~~,~~ contributes substantially to possibilities of adjusting the coupling level and compensating the coupler. In turn, this makes possible to obtain high directivity of the coupler.

Please amend the paragraph beginning at page 3, line 24, as follows:

The ~~inventions~~ <u>technology in this case</u> makes it possible to adjust the relationship between the distance, between the first and the second line, and each distance, between the first line and the respective tuning ground plane, so as to contribute to a desired coupling level under compensation conditions. More in particular, adjusting the distance between the tuning ground plane(s) and the first line also changes the coupling level. So, the coupling level and obtaining the compensation condition should be tuned in parallel.

Please amend the paragraph beginning at page 4, line 1, as follows:

Preferably, the width of the first and/or the second line are adapted so as to contribute to a desired coupling level under compensation conditions. This means that ~~said~~ parameters also could be adjusted to reach compensation conditions. More specifically, widths of the first and the second lines can be adjusted to match the first and the second line to desired impedance, preferably 50 ohms.

Please amend the paragraph beginning at page 4, line 7, as follows:

In principle, four parameters can be adjusted, namely (i) the distance between the first and the second line, (ii) the distance between the tuning ground plane(s) and the first line, (iii) the width of the first line, and (iv) the width of the second line, in order to obtain ~~(i) equalisation~~ equalization of capacitive and inductive coupling coefficients, and suitable values of ~~(ii)~~ the coupling level, ~~(iii)~~ impedance of the first line, and ~~(iv)~~ impedance of the second line.

Please amend the paragraph beginning at page 4, line 29, as follows:

Preferably, the first line comprises at least two strips separated in a vertical direction and electrically joined by ~~means of~~ at least one connection. Thereby, it is possible to obtain the first line with a low insertion loss and that can carry a high power of a transmitted signal. Additionally, where dielectric material is used to separate the strips~~,~~ and ~~the former~~ is milled out so that a so-called quasi-air line is created, almost no dielectric losses occur ~~in the former~~, since the conductive layers, or strips, have the same electrical potential, and the electromagnetic field doesn't penetrate the dielectric material.

Please amend the paragraph beginning at page 5, line 18, as follows:

The object is also reached with a method for achieving coupling in a directional coupler under compensated conditions, the coupler comprising coupled lines including a first and a second line, and at least one ground plane, characterised in that ~~it~~ the method comprises choosing a distance, between the first and the second line, and each distance, between the first line and an edge of at least one of the ground planes, so as to contribute to a desired coupling level under compensation conditions.

Please amend the paragraph beginning at page 6, line 7, as follows:

- fig. 3 shows a sectional view of a coupled lines directional coupler according to a first embodiment ~~of the invention~~, sectioned perpendicular to the coupled lines,

Please amend the paragraph beginning at page 6, line 13, as follows:

- fig. 5 shows a sectional view of a coupled lines directional coupler according to a second embodiment ~~of the invention~~, sectioned perpendicular to the coupled lines,

Please amend the paragraph beginning at page 6, line 20, as follows:

- fig. 7 shows a sectional view of a coupled lines directional coupler according to a further embodiment ~~of the invention~~, sectioned perpendicular to the coupled lines,

Please amend the paragraph beginning at page 6, line 28, as follows:

- fig. 9-13 show sectional views of coupled lines directional couplers according to additional embodiments ~~of the invention~~, sectioned perpendicular to the coupled lines,

Please amend the paragraph beginning at page 7, line 8, as follows:

- fig. 15 shows a sectional view of a coupled lines directional coupler according to a further embodiment~~ of the invention~~, sectioned perpendicular to the coupled lines.

Please amend the paragraph beginning at page 7, line 14, as follows:

In Fig. 3, cross-section of a structure of a coupled lines directional coupler according to a first non-limiting example embodiment ~~of the invention~~ is presented. Like other non-limiting example embodiments~~ of the invention~~, it is suitable for multilayer printed circuit technologies and weak couplings. It comprises a first dielectric layer 1, a second dielectric layer 2 and a third ~~3~~ dielectric layer 3 in the form of substrates. The first dielectric layer 1 is located above the second dielectric layer 2, and the second dielectric layer 2 is located above the third dielectric layer 3. The coupler comprises a first conductive layer 4, a second conductive layer 5, a third conductive layer 6 and a fourth ~~7~~ conductive layer 7. The first conductive layer 4 is located on top of the first dielectric layer 1. The second conductive layer 5 is located between the first dielectric layer 1 and the second dielectric layer 2. The third conductive layer 6 is located between the second dielectric layer 2 and the third dielectric layer 3. The fourth conductive layer 7 is located below the third dielectric layer 3.

Please amend the paragraph beginning at page 7, line 27, as follows;

Coupled lines 8, 9, in the form of strips, preferably straight and parallel, and having a longitudinal axis, here referred to as a first line 8 and a second ~~9~~ line 9, are formed in the first

conductive layer 4 and the third ~~6~~ conductive layer 6, respectively. In the description of example embodiments ~~of this invention~~, the first line 8 is also referred to as a main line.

Please amend the paragraph beginning at page 8, line 1, as follows:

In any embodiment ~~of the invention~~, the first and second lines could also be arranged so that the distance between them varies, for example in a case where one of them, or both, are tapered or curved, or in a case where they are straight but non-parallel. For this presentation, the longitudinal axis of the coupled lines is defined as the longitudinal direction of the mass distribution of both lines. In a case where the coupled lines are straight and parallel, the longitudinal axis of the coupled lines is parallel to each of them.

Please amend the paragraph beginning at page 8, line 16, as follows:

In the first 4, second 5, third 6 and fourth 7 conductive layer, a respective first ground plane 10, 10', second ground plane 11, 11', third ground plane 12, 12' and fourth ~~13~~ ground plane 13 are formed. The fourth ground plane 13 is also referred to as a lower ground plane 13. The first ground plane 10, 10', second ground plane 11, 11', and third ground plane 12, 12' ground plane each include a first region 10, 11, 12, and a second region, 10', 11', 12', which are, in a direction parallel to the ground planes and perpendicular to the longitudinal direction of the coupled lines 8, 9, located on opposite sides of the first line 8.

Please amend the paragraph beginning at page 9, line 19, as follows:

As can be seen in fig. 3, the tuning ground plane 11 is located, in a direction perpendicular to the ground planes, ~~located~~ between the first 8 and the second line 9. The first line 8 and the tuning

ground plane 11, formed in separate conductive layers, are located at a vertical distance from each other, which is approximately equal to the thickness of the first dielectric layer 1.

Please amend the paragraph beginning at page 9, line 25, as follows:

As described further below with reference to fig. 4 and 4a, a horizontal distance 15 between the first line 8 and an edge 11a of the tuning ground plane 11 is adjusted to achieve compensation conditions for a wide range of weak couplings as shown in fig. 3.

Please amend the paragraph beginning at page 9, line 29, as follows:

The first region 10 of the first ground plane is placed at the same distance 17 (see fig. 3) from the first line 8 as the second region 10'. However, as an alternative, the distances 16, 17 between the first region 10 of the first ground plane and the first line 8, and the second region 10' of the first ground plane and the first line 8 could be un-equal. In fact, the first region 10 of the first ground plane could be used a supplementary tuning ground plane, whereby the distance 17 between the edge of the first region 10 of the first ground plane and the first line 8 could be adjusted along with the distance 15 between the first region 11 of the second ground plane and the first line 8 to achieve compensation conditions for a wide range of weak couplings.

Please amend the paragraph beginning at page 10, line 9, as follows:

Fig. 4 shows results of calculations of the coupling coefficients C of the coupler described above, as a function of the horizontal distance 15 between the first line 8 and the tuning ground plane 11 (fig. 3), and the horizontal distance 14 between the first line 8 and the second ~~9~~ line 9 as a parameter. The permittivity of the dielectric layers is referred to as eps1, eps2, and eps3. eps1

and eps3 values are typical for a core material, and eps2 value is typical for a prepreg material as shown in fig. 4B. As shown in the curves of fig. 4, kc and kl refer to the capacitive and inductive coupling coefficients, respectively. The directional coupler is compensated if these two coefficients are equal and the ports of the coupler are terminated, in this case with 50 Ohms impedance. It can be seen in fig. 4 that the configuration assures wide range of weak couplings, i.e. from -20 dB to -37 dB and beyond, while being compensated. To clarify that these are weak coupling levels, it is pointed out that –20 dB correspond to a ratio between the power transferred to the second line 9 and the total power propagated in the main line 8 of 0.01, and –30 dB correspond to a ratio between the power transferred to the second line 9 and the total power propagated in the main line 8 of 0.001. The ground plane 11 has a central function in adjusting the coupling level and to compensate the coupler. The coupling level can be adjusted by changing the distance 14 between the first line 8 and the second line 9 and adjusting the distance 15 between the first line 8 and the tuning ground plane 11. The adjustment of the distance 15 between the first line 8 and the tuning ground plane 11 will also tune the coupler to the compensation conditions. At the same time width of the first line 8 and the second line 9 should be adjusted to fulfil the matching condition of the compensation conditions. These widths vary from 120 to 126 mils for the line 8 and from 21 to 31 mils for the line 9 when the first 14 and the second 15 horizontal distances vary over the range shown in fig. 4.

Please amend the paragraph beginning at page 11, line 5, as follows:

Fig. 5 shows a directional coupler according to a second embodiment of the invention. The physical configuration of the second embodiment is similar to the first embodiment described with reference to fig. 3, except for the following. Differing from the first embodiment, the

second line 9 is formed in the second conductive layer 5. Thus, in this embodiment, the vertical distance between the coupled lines is approximately equal to the thickness of the first dielectric layer 1. Further, differing from the denotation used with reference to fig. 3, in the third conductive layer 6, a second ground plane 11, 11' is formed, and in the second conductive layer 5 a third ground plane 12, 12' is formed. The second line 9 is, in a direction perpendicular to the ground planes, located between the first line 8 and the first region of the second ground plane 11. The vertical distance between the first line 8 and the first region of the second ground plane 11 is approximately equal to the sum of the thicknesses of the first dielectric layer 1 and the second ~~2~~ dielectric layer 2.

Please amend the paragraph beginning at page 12, line 1 as follows:

As an alternative, only the distance 15 can be adjusted for compensation, whereby the first region 10 and the second ~~10'~~ region 10'of the first ground plane could be placed with preferable equal distances 16, 17 from the first line 8.

Please amend the paragraph beginning at page 12, line 5, as follows:

Fig. 6 shows results of calculations of the coupling coefficients, of the coupler described with reference to fig. 5, as a function of the horizontal distances 15, 17 (s) (see fig. 6a) between the first line 8 and the tuning ground planes 10, 11, and the horizontal distance 14 between the first 8 and the second 9 line as a parameter (s1) (see fig. 6a). Thus, in fig. 6 the results are obtained by setting the horizontal distance 17 (see fig. 5) between the first line 8 and the tuning ground plane 10 equal to the horizontal distance 15 between the first line 8 and the tuning ground plane 11.

Please amend the paragraph beginning at page 13, line 8, as follows:

Surprisingly, it has been found that weak couplings at compensation conditions can be obtained with a big difference in propagation velocities of two orthogonal modes propagated in the coupled lines. This is illustrated in fig. 8 and 8a, in which effective dielectric constants (eps eff c and eps eff pi) calculated for two orthogonal modes c and pi propagated in the coupled lines in configuration shown in fig. 7, and a cross-section corresponding to the one in fig. 7 to explain variables in the diagram, are presented. Dielectric permittivity of the dielectric layers is chosen to be the same for each layer, and equal to 3.6. In fig. 8, eps eff c corresponds to the wave propagated in the stripline 9. Notice, that if the stripline 9 is covered with the tuning ground plane 11, which corresponds to small values of s, effective dielectric constant for this mode is equal to the dielectric permittivity of the dielectric layers, as it should be for the stripline 9. eps eff pi corresponds to the wave propagated in the microstripline 8 and differs very much from eps eff c.

Please amend the paragraph beginning at page 13, line 22, as follows:

Further modifications of the configurations described above are possible within the scope of the present invention. On the side of the first line 8 opposite to the side where the second line 9 and the tuning ground plane 11 are positioned, any arrangement of the ground planes 10', 11' and 12' is possible. Thereby, only some of the ~~latter~~ ground planes 10', 11' and 12' can be present, or all of them can be omitted. The ground planes positioned at the vicinity of the first 8 or the second line 9 can be useful for tuning these lines to the terminating impedance (50 Ohms) at convenient geometrical dimensions.

Please amend the paragraph beginning at page 14, line 1, as follows:

Fig. 9 shows an alternative configuration in which positions of a first line 8, a second line 9 and a tuning ground plane 11 corresponds to the positions of the respective corresponding elements in the configuration shown in fig. 7. Additionally, a second ground plane region 11' formed in the same conductive layer as the tuning ground plane is presented, in a horizontal direction, on the opposite side of the first line 8. Also, in a horizontal direction, on the same side of the first line 8 as the tuning ground plane 11, a first ground plane 10 is formed on the same conductive layer as the first line 8, and located at a distance 17 from the ~~latter~~first line 8. The first ground plane 10 can be used as a supplementary tuning ground plane, whereby compensation conditions for a wide variety of weak couplings can be achieved by suitable adjustment of the horizontal distance 15 between an edge 11a of the tuning ground plane 11 and the first line 8, as well as the horizontal distance 17 between an edge 10a of the tuning ground plane 10 and the first line 8.

Please amend the paragraph beginning at page 16, line 16, as follows:

Another alternative embodiment ~~of the invention~~ presents a directional coupler shown in a cross sectional view in fig. 12. This coupler is convenient for construction of stand-alone couplers. The only difference between this embodiment and the one shown in fig. 11 is the lack of microstrip-type transmission medium. The quasi air-filled first line 8 and strip-type second line 9 are used to compose the coupler. Compensation of the coupler is possible by proper adjusting of horizontal distances 15, and 24, between the edges 11a, 13a of ground planes 11 and 13, and the edge of a dielectric material surrounding the second line 9, i.e. the distances 26, 27 between the ground planes 11, 13 and the first line 8. The distances 15 and 24 can be set equal or different.

Please amend the paragraph beginning at page 17, line 8, as follows:

Surprisingly it has been found that couplers built according to the embodiments presented in ~~fig.~~ figs. 11, 12, and 13 can be compensated. The difference in propagation velocities of two orthogonal modes propagated in the coupled lines is even larger in said embodiments than in the embodiments presented with reference to ~~fig.~~ figs. 3, 5, 7, 9, and 10. This is illustrated in fig. 14a-~~c~~14c in which inductive and capacitive coupling coefficients kL, kC, (see fig. 14b) and effective dielectric constants eps eff c, eps eff pi for two orthogonal modes propagated in the coupled lines in the configuration similar to the one shows in fig. 13, and a cross-section similar to the one in fig. 13 to explain variables in the diagrams, are presented. (Dissimilarities between the configurations in fig. 13 and 14c are not essential.) Note that the coupler is compensated for s being about 0.75 mm, where curves of coupling coefficients cross each other. Also, note that effective dielectric constants of two modes are almost equal to the dielectric constants of two different media surrounding the coupled transmission lines: 1 for air surrounding the coaxial line, and eps for the dielectric of the strip line.

Please amend the paragraph beginning at page 17, line 23, as follows:

Yet another alternative embodiment is presented in fig. 15. This includes a simple coaxial line - microstripline configuration. The coupler is compensated by proper adjustment of the horizontal distance 24 between the left vertical edge of the ground plane 13 and the left vertical edge of the dielectric layer 3.